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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number: WO 92/17664
E04C 2/52 // E04B 5/48	A1	(43) International Publication Date: 15 October 1992 (15.10.92)

(21) International Application Number: PCT/NO92/00052

(22) International Filing Date: 27 March 1992 (27.03.92)

(30) Priority data:
911311 4 April 1991 (04.04.91) NO

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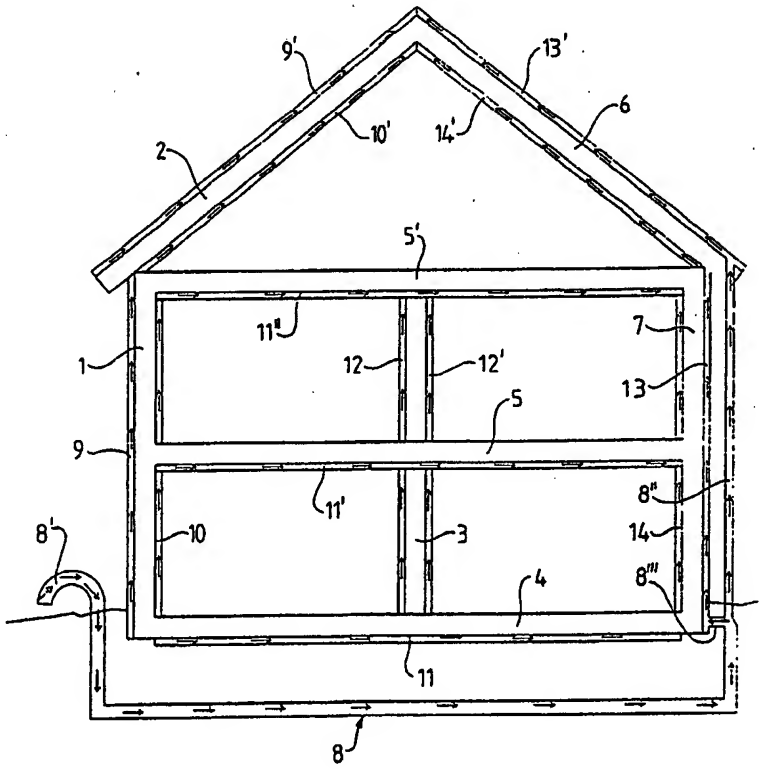
(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC (European patent), MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, RU, SD, SE, SE (European patent), SN (OAPI patent), TD (OAPI patent), TG (OAPI patent), US.

Published
With international search report.
In English translation (filed in Norwegian).

(54) Title: TEMPERATURE REGULATION OF VARIOUS BUILDING PARTS OF HOUSES

(57) Abstract

The invention relates to low-energy houses and building parts (floor, tier of beams, external and internal walls, roof/ceiling) for the same. One has aimed at avoiding use of advanced technique and expensive equipment, so that the building parts (1, 2, 3, 4, 5, 5', 6, 7) themselves effect solar energy catching, transport and storage. Thus, a building part according to the invention will comprise two channel systems (e.g. 9, 10; 9', 10'; 13, 14; 13', 14') for air or other gaseous heat-carrying medium and a heat-accumulating layer, e.g. of concrete, so that the respective building part in mounted condition will exhibit an upper and a lower respectively an outer and an inner channel system.



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TEMPERATURE REGULATION OF VARIOUS BUILDING PARTS OF HOUSES

This invention relates to temperature regulation of various building parts of houses and is closer defined in the preamble of the following claim 1. Under the term house building parts fall i.a., but not exclusively, floors on ground (basement floors), story-separating tiers of beams (pavements), external and internal walls as well as roof (ceiling and external roof construction).

In a temperature regulation system according to the invention, sun energy and/or earth heat/cool are utilized for heating or cooling, respectively, one or more of the above-mentioned house building parts. The relatively high temperature of the earth heat during the winter is, thus, suitably utilized for heating purposes in the winter time and its relatively low temperature in the summer for cooling purposes.

The house building parts according to the invention are to be formed with a view to facilitate industrial element making, they shall exhibit good static strength properties, allow great architectonic freedom of choice, as well as exhibiting great flexibility combined with an optimal resource utilization.

According to one aspect of the present invention, a complete

sun energy/earth heat-utilizating house has been provided, comprising all or most of said building parts which are formed for partly accumulate energy, partly to function as a channel system for conveying hot/cold air to other building parts to be heated or cooled, respectively. According to another aspect some building parts formed in accordance with the present invention may be used in combination with more conventionally formed building components and/or elements in order to allocate the combination certain properties, e.g. heat in combination with floor.

Socalled air-based sun heat plants represents known technology which has been practiced with a good result from a pure heating technical point of view. Sun-energy houses distinguish themselves disadvantageously from an architectonic point of view, and the use of e.g. separate glass rooms for catching sun energy represents an obvious deficiency reducing the area to be occupied by the inhabitants. The socalled low-energy houses suffer from the same deficiencies and disadvantages.

Common to all known sun energy-utilizing house buildings is the use of advanced heat pumps which are complex in construction and function as well as expensive to procure. Existing heat pump constructions have also a very limited useful life. Heat storages in such energy houses consist often of water tanks, stone embarkments, salt layers and the like. Only very seldom the building parts themselves are used as heat storages.

Known materials, components and systems for the purpose concerned are i.a. transparent insulation materials, window constructions having an optimal k-value, combined heating and ventilating systems, advanced control systems, sun-cell-operated systems, new thermical heat storing materials and energy-efficient technical equipment.

Storage of heat in floor is e.g. described in SE patent specification No. 196,303, which discloses a system which gives a good insulation against the ground by means of a thick overlying concrete layer wherein helical-folded channels, socalled spiropipes, for the circulation of hot air are arranged. Here, the heat medium is hot air, and the concrete layer or floor constitutes the heat storage.

SE patent applications Nos. 8903732-9 and 9002969-5 disclose tiers of beams comprising crossing currugated plates with overlying concrete layer. The crossing cavities of the the corrugated plates form a suitable channel system for circulation and transport of air or other gaseous heat-carrying medium, the overlying concrete layer acting as heat storage. Within the concrete or below the crossing corrugated plates extend channels in the form of said spiropipes the task of which is to convey newly heated air to the edges of the house before the air is conducted in between the crossing corrugated plates.

From NO laying-out publication No. 150.736 an element system is known, comprising two parallel plates with intermediate distancers, between which channels are formed for the guidance of air or other gas in one direction. One can achieve the same effect by deleting the distancers and use at least one corrugated plate. By using such elements or building parts as floor or tier of beams in a house, this known system aims at providing a rapid temperature regulation of the overlying room through an optimal direct heat transfer, i.e. without a previous storage of the heat.

Other known temperature regulation systems for house buildings comprise conventional heating through heating panels, heat cables and water-based pipe systems in floor, radiant heat from ceiling and/or pre-heated ventilation air.

As far as building parts for houses generally are concerned, these are substantially constructed in a conventional way,

i.e. mainly with their primary task in view. Building parts for roof and external walls are to be tight to wind and weather, exhibit the necessary strength properties with regard to pressure, tension and bending moment as well as having a nature satisfying the requirements to sound and heat insulation. The primary task for floor on ground (basement floor) comprises vapour density against ground, strength and stiffness as well as satisfactory insulating properties. For story-separating tiers of beams and internal walls, the primary function comprises room-separating properties, strength, rigidity, sound and heat insulating properties as well as fire-resistant nature. All these conventional building parts for houses may comprise constituents of wood, concrete, light weight concrete, metal (especially steel and aluminium), etc., as well as combinations thereof.

When socalled energy-houses generally are concerned (houses having solar cell panels, glass rooms, heat storages, heat pumps, heat transfer channel systems and temperature regulation, etc.), these are substantially more expensive than conventional houses having the same dimensions; this in spite of the fact that many of the building parts included in energy-houses are more or less conventional in their construction. The main reason for energy-houses generally being much more expensive than ordinary houses is the use of advanced technique comprising heat pumps, complex control systems, etc., as well as heat storing systems not constituting an integral part of the inhabitable area of the house building itself, i.a. socalled external glass rooms, sun-catching systems, etc. Sun energy-houses must often be allocated a particular architecture, which by many is considered to be less attactive. Use of said advanced technique also involve a high risk for functional errors, operational disturbances and so forth, causing high maintenance and replacement costs.

None of the known sun energy-houses and associated systems

have up to now reached a state wherein they may be considered fit for production in an industrial scale and commercialization.

Therefore, according to the present invention, one has aimed at eliminating or substantially reducing the above-mentioned disadvantages, deficiencies and limitation of use in prior art technique at the field concerned. This object is according to the invention to be effected through the use of new house building parts which individually and particularly in suitable combinations, in addition to their general functions and without interferring detrimentally or vitiating on these functions, without or without noticeable price increase, are to exhibit properties promoting catching, transfer and storage of thermal energy. A temperature regulating system according to the present invention shall further comprise house building parts which, at least, have the same architectonic flexibility as quite ordinary components for the same purpose. It represents an obvious advantage with the invention, but not a binding presupposition for the successful practical execution thereof, that all house building parts (floor on ground (basement floor), story-separating tiers of beams (pavement), external and internal walls as well as ceiling/ roof construction) exhibit the same general construction, which should prove the best criterion for a rational industrial production.

In accordance with the invention, said objects are realized through the features appearing from the following claims.

According to the invention, all building parts are to be incorporated as an integral part of the house construction and are presupposed to fulfil all their primary functions as well as additional functions. These additional functions will, of course, differ for external building parts (roof, external walls) on the one hand and internal building parts (inner walls, floor on ground, tier of beams) on the other

hand, in that normally only external wall/walls (dependent on the orientation in relation to north/south) and roof will be sun heat-catching.

Normally, house building parts according to the invention will, thus, be formed such that they all have a heat storing capacity as well as comprising a channel system for the circulation and transport of air or other heat-carrying gaseous fluid, in that the outer building parts such as external walls and roof in addition will exhibit a sun-catching function. For external walls and roof the design and choice of materials preferably should be such that a minimum use of ordinary insulating materials is required. Thereby, the house building parts formed in accordance with the invention may be dimensioned with a thickness substantially corresponding to conventional building elements of the same category.

In relation to a central core which may form the separating layer of the building part, it is suitable to form outer channel systems, which in relation to the invironment will form one external and one internal channel system. The external channel system may advantageously be utilized to make use of earth heat from a pipe system placed below frost-proof depth. The internal channel system may constitute an active heat storage. Also the internal walls may be built according to this principle. Also for floor on ground one may use two separate channel systems, namely an upper (inner) channel system and a lower (outer) channel system. Thereby, one may i.a. avoid to install helical-folded channels, spiropipes, which distinguish many previous systems. Likewise, according to the invention, one achieves a very large contact surface for giving off heat/cold. In connection with sun energy-houses such a floor may advantageously be utilized as primary heat-accumulating body for sun energy.

In relation to previously described SE patent applications

Nos. 88903732-9 and 9002969-5, corresponding corrugated plates are located with the corrugations orientated in the same direction, whereby is achieved a substantial static capacity improvement, simultaneously as the formwork operations before concrete casting are simplified, as well as some reinforcement is saved. Likewise, in relation to prior art technique, one avoids to use a large number of laterally extending plates.

A sun energy house, possibly equipped with an earth heat-utilizing system, constructed from building parts according to the invention, will act as a large heat exchanger, wherein one may renounce advanced technical extra equipment such as heat pumps, external glass rooms, etc.

Examples of useful embodiments are further explained in the following, reference being made to the accompanying diagrammatical drawings, wherein:

Figure 1 represents a principle sketch of a sun energy house having the possibility of earth heat-utilization, as seen in a cross-section parallel to the gable sides of the ridge roof house;

Figures 2 - 6 show cross-sections through various building parts for the construction of the house according to figure 1 or a similar house, in that:

Figure 2 shows a building part which in the house is thought used as a floor upon ground (basement floor);

Figure 3 shows a building part which in the house is thought used as story-separating tier of beams;

Figure 4 shows a building part which is thought used as an external wall;

Figure 5 shows a roof element;

Figure 6 shows an internal wall.

Reference is first made to figure 1 wherein the reference numeral 1 denotes an external wall at the sun side, 2 denoting external roof at the sun side, while 3 and 4 indicate a room-separating internal wall of the sub floor (or the basement) and a floor upon ground, respectively. Further, the reference numerals 5, 6 and 7 denote tiers of beams (the uppermost is defined at 5'), roof at the shadow side and external wall at the shadow side, respectively.

The separate building parts of figures 2 - 6 are given the same general reference numerals.

Further, in figure 1 the reference numeral 8 denotes a pipe system placed beneath frost-proof depth for the utilization of earth heat and having an air inlet 8' above ground level as well as an upwardly extending branch pipe 8" which will be properly heat insulated. Such a pipe system will usually be placed in a ditch located outside the foundation and may have a quite substantial extent. Air entering the air inlet 8' may have a temperature of several minus degrees, but may be heated by means of the earth heat to about 5°C before ascending into the branch pipe 8".

9 and 9' denote an external air layer included in external wall 1 and roof 2, respectively, at the sun side, and which is intended to act as sun-catcher. Likewise, an air channel 10 has been formed at the inner side of the house's sun side. The reference numerals 11,11' and 11" denote air channels for floor on ground and tier of beams, respectively. 12,12',13,13' and 14,14' denote respectively air channels of internal wall, external air channels at the shadow side and internal air channels.

Reference is now made to figures 2 - 6, wherein the building parts shown have the following common components which all are through-going and extend parallel to the outer faces of

the respective building part: a) a concrete layer (denoted 15a-15e, respectively), b) a corrugated plate (denoted 16a-16e, respectively) of steel, aluminium, plastic or the like, c) a spacer element (denoted 17a-17e, respectively) and d) a further currugated plate (denoted 18a-18e, respectively) which may be identical with the first-mentioned corrugated plate as well as being orientated in the same direction as the latter (i.e. not crossing as in prior art technique).

The reference numerals of the air layers/air channel systems of figure 1 have been transferred to figures 2 - 6.

More specifically, figure 2 shows a building part which is thought used as floor 4 on ground, comprising the two mentioned corrugated plates 16a and 18a as well as the distance-maintaining element 17a. 19a denotes an insulation layer, usually expanded polystyrene, whilst 20a is a further distancer of plate element of any suitable material.

The tier of beams according to figure 3 has a construction corresponding to figure 2 and common parts are indicated by similar reference numerals 16b-20b, in that 21b defines a ceiling plate of desired nature and appearance.

Figure 4 shows a building part which is thought used as external wall, comprising corrugated plates, spacer element and concrete layer corresponding to figures 2 and 3, and wherein the reference numerals correspond, in that 22c and 23c denote laths and insulation, whilst 24c indicates a wind sealing plate, e.g. a wood fibre plate. 25c and 26c indicate again laths and external clothing in the form of corrugated plates, wooden plates or the like. 27c, 28c, 29c denote respectively a lath, an internal building plate, e.g. a plaster plate, and vertical reinforcement.

The building part (the roof element) according to figure 5 comprises the same corrugated plates and spacer element, 16d,18d and 17d as in the preceding figures, in that 22d and

23d indicate laths and insulation as in figures 3 and 4. 30d denotes a sub roof, e.g. of plywood, whilst 31d and 32d indicate laths and 33d a roof coating, e.g. of corrugated steel or aluminium plates (preferably of the type which by appearance may resemble glazed roof tiles) or suitable types of roof coating onto which laths are intended to be nailed. 34d indicates an internal lath and 35d a building or ceiling plate of suitable type, e.g. a plaster plate, whilst 29d indicates vertical reinforcement.

Figure 6 shows a building part for houses and which is thought used as internal wall, and which in principle is constructed in the same manner as the building parts according to the preceding figures, i.e. comprising two corrugated plates 16e and 18e having an intermediate spacer and separating layer 17e of concrete. As in the embodiment of figure 5, the reference numerals 29e,34e and 35e respectively denote reinforcement, laths and building plate, e.g. a plaster plate.

Again, reference is made to figure 1 wherein sun energy caught by the sun-radiated surfaces 9 and 9' of respectively external wall 1 and roof 2 at the sun side, in the form of heated air between the wind sealing plate 24 and external clothing 26c, respectively sub roof 30d and roof coating 33d is conducted within a separate pipe system by means of simple mechanical fans to a heat-accumulating body, a socalled heat storage, which primarily may consist of the concrete layer 15a in floor (figure 2) on ground and secondarily of the concrete layer 15b in tier of beams 5,5' (figure 3). When one assumes that sufficient heat energy has been accumulated within said building parts 4 and 5,5', the heat accumulation is continued within the respective concrete layer 15c-15e in external wall 1,7 (figure 4), roof 2,6 (figure 5) and internal walls 3 (figure 6).

On sunny days, the external wall of roof surface of the house at the sun side receive a so large amount of heat

energy that the air immediately inwardly of the external wall and roof surface may be heated to about 80°C. The use of dark, e.g. black-coloured wall front and roofing materials 26c respectively 33d will favour the catching of the sun ray energy. This heated air is then conducted primarily to the building part 4 (the basement floor) and into the channel system thereof defined by the corrugated plate 18a and the insulation layer 19a, for then to be conducted further to the uppermost channel system defined by the corrugated plates 16a,18a and the spacer elements 17a. Via the lower and upper air channel systems in floor on ground and tier of beams and the internal channel system in external walls and roof, as well as channel systems at either side of the internal walls, the air becomes distributed over the entire house building. The concrete layer 15a-15e in the respective building parts may at any time function as heat-accumulating body.

When the sun-heated air has passed through the channel systems in floor 4 on ground and a portion of the heat energy of the air has been caught and accumulated within the concrete layer 15a of the basement floor 4, figure 2, somewhat cooler air, e.g. through an insulated helical-folded channel, not shown, becomes conducted further to the tier of beams 5,5', figure 3. Here, the air is conducted into the channel system between the corrugated plate 18b and the insulation layer 19b, for then to be conducted further between the corrugated plates 16b and 18b and the spacer elements 17b, in that some heat energy will be accumulated within the concrete layer 15b. The air is conducted further within registering channel systems in adjacent building parts, and provided that there still is heat energy to be extracted from the air after it has passed through the tier of beams 5,5' (it is then a question of air having a temperature higher than about 25°C), this air is conducted further through an insulated pipe to e.g. the channel system 14' in roof 6 at the shadow side. Thereafter, if the air still contains heat energy capable of being stored, this air

might be conducted into internal and/or external wall 3 and/or 7 via registering channel systems.

The earth heat-utilizing ground pipe system 8,8',8", wherein the rising pipe 8" leads upwards to the channel system 14' of the roof 6 at the shadow side, may have a short branch pipe 8''' leading to the channel system 13 of the external wall 7 at the shadow side. Such branch pipes 8''' are presupposed to be arranged at all sides of the house, and that rising pipes 8" lead to roof at two sides.

It is presupposed that the air of this ground pipe's underground portion will have a temperature of about 5°C summer as well as winter, so that air having passed through the ground pipe system in the summer, may be used for cooling purposes. Otherwise, this air which is heated in the winter (provided that the outdoor air has a lower temperature than 5°C), is conducted into the external channel systems of the outer building parts, e.g. 6,7, and there cause an insulating effect improving the heat energy economy of the house.

C l a i m s

1. A building part for any type of building, but particularly for a low-energy house, and especially one having possibilties for solar energy utilization, comprising a channel system for the circulation of air or other gas as heat-carrying medium and at least one heat-accumulating layer (15a-15e), and wherein the building part comprises a further channel system separated from the first-mentioned channel system, said channel systems extending parallel to the main faces of the building part, such that in the bulding part's position of use as floor (4) on ground, tier of beams (5,5') respectively wall (1,3,7) or roof/ceiling (2,6), an upper and lower respectively an inner and outer channel system result, and wherein the two channel systems each is formed by a corrugated plate (16a-16e, 18a-18e) and the heat-accumulating layer (15a-15e) preferably consists of concrete, c h a r a c t e r i z e d i n that the corrugated plates (16a-16e, 18a-18e) are orientated with the corrugations in the same direction, and that the corrugated plates are attached to intermediate spacer elements (17a-17e).

2. A building part as set forth in claim 1 and intended used as floor (4) on ground respectively as tier of beams (5,5'), c h a r a c t e r i z e d i n that the heat-accumulating layer (15a;15b) forms one main face of the building part, so that the two channel systems are situated at the same side of the heat-accumulating layer (15a;15b).

3. A building part as set forth in claim 1 and intended used as internal wall (3), external wall (1,7) or roof/ceiling (2,6), c h a r a c t e r i z e d i n that the heat-accumulating layer (15c;15d;15e) is situated between the two channel systems.

4. A building, especially a low-energy house, c h a r a c t e r i z e d i n that it is constructed from

building parts according to one or more of the preceding claims.

5. A building, especially a low-energy house as set forth in claim 4, c h a r a c t e r i z e d i n that one or more of the channel systems thereof is/are coupled to a pipe system (8-8''') which is partly digged into the ground beneath frost-proof depth.

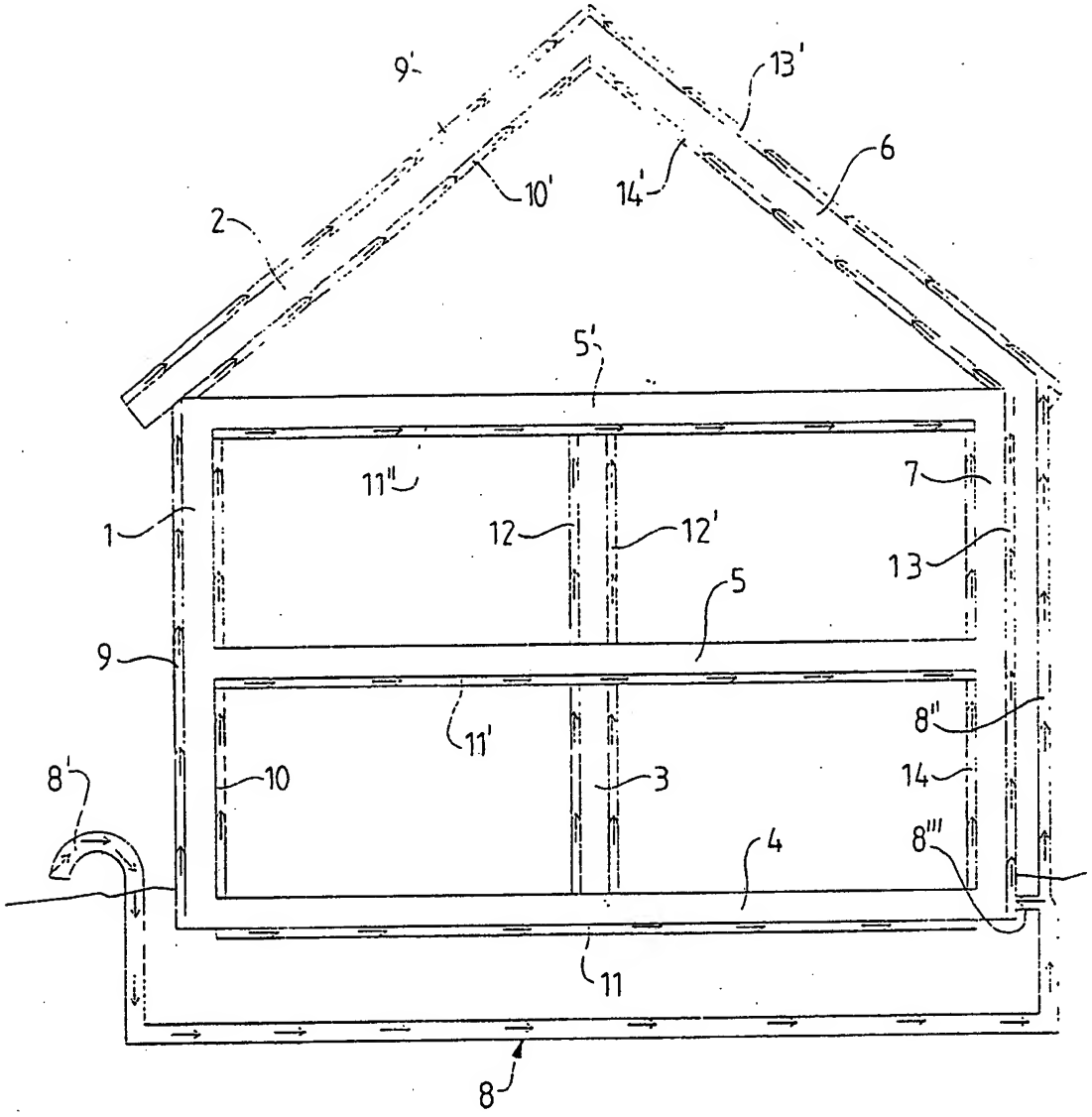


Fig.1

Fig.2

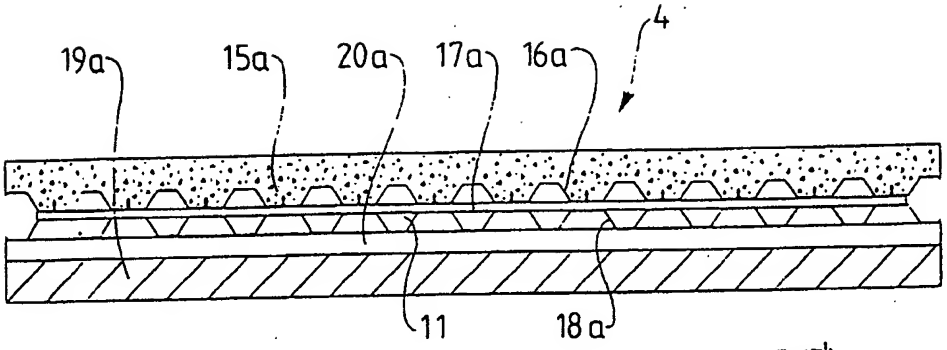


Fig.3

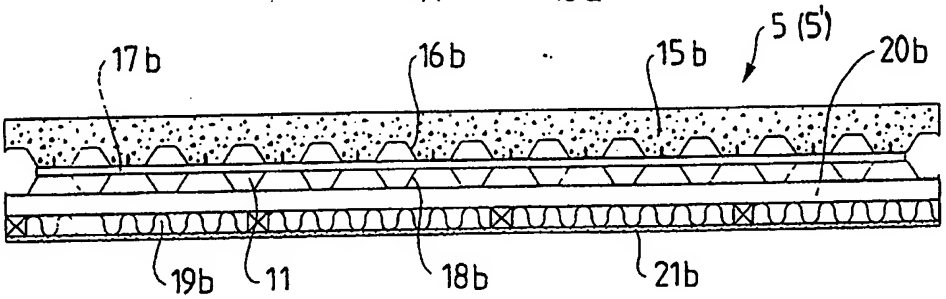


Fig.4

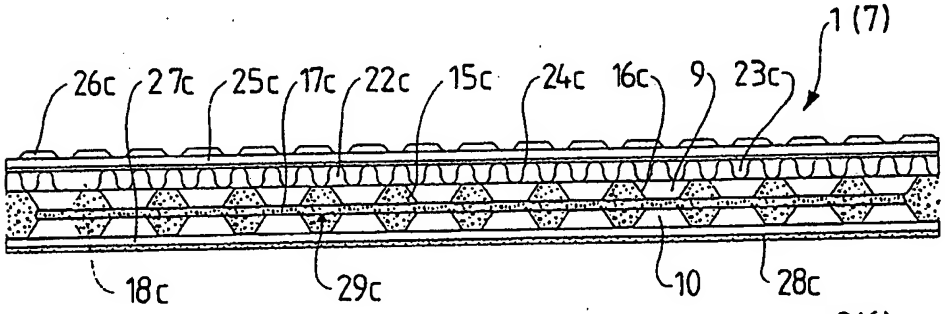


Fig.5

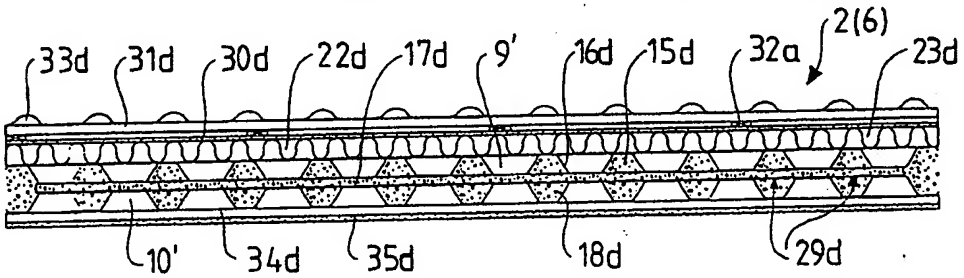
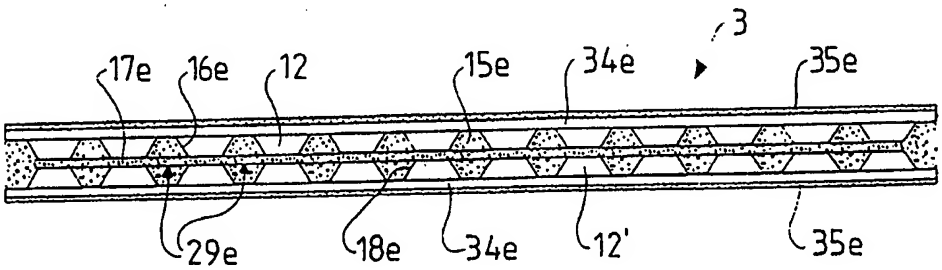


Fig.6



INTERNATIONAL SEARCH REPORT

International Application No PCT/NO 92/00052

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: E 04 C 2/52 // E 04 B 5/48

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	E 04 B; E 04 C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
Y	NO, B, 150736 (IMENCO A/S) 27 August 1984, see figure 1 --	1,4
Y	FR, A5, 1024889 (J.-R. KLING) 8 April 1953, see figure 6 --	1,4
A	DE, A1, 1609802 (RIGIPS BAUSTOFFWERKE GMBH) 30 April 1970, see figure 1 --	
A	NO, B, 137218 (SINTEF) 10 October 1977, see figure 10a --	
A	WO, A1, 9107557 (LEGALETT SVENSKA AB) 30 May 1991, see figure 1 --	

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
30th June 1992	1992 -07- 02
International Searching Authority	Signature of Authorized Officer
SWEDISH PATENT OFFICE	Vilho Juvonen

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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	US, A, 4637184 (W. RADTKE ET AL) 20 January 1987, see figure 1 --	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/NO 92/00052

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 29/05/92
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